

CLAIMS:

1. A method of forming a capacitor comprising:
forming a first capacitor electrode;
forming a first layer of a first capacitor dielectric material over
the first capacitor electrode;
forming a second layer of the first capacitor dielectric material on
the first layer; and
forming a second capacitor electrode over the second layer of the
first capacitor dielectric material.

2. The method of claim 1 comprising forming the second
capacitor electrode to impart one of compressive or tensile stress on
the second layer of the first capacitor dielectric material during second
electrode formation.

3. The method of claim 2 comprising forming the second
capacitor electrode to predominately comprise a material selected from
the group consisting of TiN_x , WN_x , TaN_x , PtRh_x , PtRu_x , PtIr_x , and
mixtures thereof.

1 4. The method of claim 2 comprising doping the second
2 capacitor electrode during its formation with a conductivity enhancing
3 impurity to achieve a selected stress on the second layer of the first
4 capacitor dielectric material.

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6 5. The method of claim 1 comprising initially forming the first
7 layer of first material to be amorphous.

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9 6. The method of claim 1 comprising initially forming the first
10 layer of first material to be crystalline.

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12 7. The method of claim 1 comprising initially forming the
13 second layer of first material to be amorphous.

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15 8. The method of claim 1 comprising initially forming the
16 second layer of first material to be crystalline.

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18 9. The method of claim 1 comprising initially forming the first
19 layer of first material to be amorphous, and initially forming the second
20 layer of first material to be amorphous.

1 10. The method of claim 1 comprising initially forming the first
2 layer of first material to be amorphous, and transforming the first layer
3 of first material to be substantially crystalline prior to forming the
4 second layer of first material, the second layer of first material initially
5 being formed to be amorphous.

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7 11. The method of claim 1 comprising initially forming the first
8 layer of first material to be amorphous, and transforming the first layer
9 of first material to be substantially crystalline prior to forming the
10 second layer of first material, the second layer of first material initially
11 being formed to be amorphous, and transforming the second layer of
12 first material to be substantially crystalline after forming another layer
13 thereover.

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15 12. The method of claim 11 wherein the another layer comprises
16 the second capacitor electrode.

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18 13. The method of claim 1 comprising initially forming the first
19 layer of first material to be amorphous, and transforming the first layer
20 of first material to be substantially crystalline prior to forming the
21 second layer of first material, the second layer of first material initially
22 being formed to be crystalline.

1 14. The method of claim 1 wherein the first layer of first
2 material is provided with a selected finished crystalline structure prior
3 to forming the second layer of first material.

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5 15. The method of claim 1 wherein the first layer of first
6 material is formed to a thickness of from 10% to 90% of a finished
7 combined thickness of the first and second layers.

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9 16. The method of claim 1 comprising forming the first layer
10 of first material to be crystalline in its final composition, and forming
11 the second layer of first material to be crystalline in its final
12 composition.

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14 17. The method of claim 1 comprising forming the first layer
15 of first material to be crystalline in its final composition, and forming
16 the second layer of first material to be amorphous in its final
17 composition.
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1 18. A method of forming a capacitor comprising:
2 forming a first capacitor electrode;
3 forming a first layer of a first capacitor dielectric material over
4 the first capacitor electrode;

5 annealing the first layer of the first capacitor dielectric material
6 at a temperature of at least 300° C for a time period sufficient to
- achieve a selected crystalline structure of the first material;

8 after annealing the first layer, forming a second layer of the first
9 capacitor dielectric material on the annealed first layer, the second layer
10 of first material not being exposed to a temperature of 500°C or
11 greater before deposition of a subsequent layer thereover; and

12 forming a second capacitor electrode over the second layer of the
13 first capacitor dielectric material.

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15 19. The method of claim 18 wherein the first dielectric material
16 comprises a titanate compound.

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18 20. The method of claim 18 wherein the first dielectric material
19 comprises Ta_2O_5 .

1 21. The method of claim 18 wherein the first dielectric material
2 is selected from the group consisting of barium strontium titanate,
3 strontium titanate, strontium bismuth titanate and lead lanthanum
4 zirconia titanate, and mixtures thereof.

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6 22. The method of claim 18 wherein the first layer is formed
7 to a thickness of from 10% to 90% of a finished combined thickness
8 of the first and second layers.

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10 23. The method of claim 18 comprising initially forming the first
11 layer of first material to be amorphous.

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13 24. The method of claim 18 comprising initially forming the
14 second layer of first material to be amorphous.

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16 25. The method of claim 18 comprising initially forming the first
17 layer of first material to be amorphous, and initially forming the second
18 layer of first material to be amorphous.

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20 26. The method of claim 18 comprising initially forming the
21 second layer of first material to be amorphous, and annealing the
22 second layer of first material at a temperature of 500°C or greater to
23 form said second layer to be crystalline.
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1 27. The method of claim 26 wherein the second layer annealing
2 occurs after forming the second capacitor electrode.

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4 28. A method of forming a capacitor comprising:
5 forming a first capacitor electrode;
6 forming a first layer of a first titanate compound comprising
7 capacitor dielectric material over the first capacitor electrode;
8 forming a second layer of a second titanate compound comprising
9 capacitor dielectric material on the first layer, the second titanate
10 compound being different from the first titanate compound; and
11 forming a second capacitor electrode over the second layer of
12 second titanate compound comprising capacitor dielectric material.

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14 29. The method of claim 28 comprising forming the second
15 capacitor electrode to impart one of compressive or tensile stress on
16 the second layer of the second titanate compound during second
17 electrode formation.

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19 30. The method of claim 29 comprising forming the second
20 capacitor electrode to predominately comprise a material selected from
21 the group consisting of TiN_x , WN_x , TaN_x , $PtRh_x$, $PtRu_x$, $PtIr_x$, and
22 mixtures thereof.
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1 31. The method of claim 29 comprising doping the second
2 capacitor electrode during its formation with a conductivity enhancing
3 impurity to achieve a selected stress on the second layer of the second
4 titanate compound.

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6 32. A method of forming a capacitor comprising:
7 forming a first capacitor electrode;
8 forming a first layer of a first titanate compound comprising
9 capacitor dielectric material over the first capacitor electrode;
10 annealing the first layer of the first titanate compound comprising
11 capacitor dielectric material at a temperature of at least 300° C for a
12 time period sufficient to achieve a selected crystalline structure of the
13 first titanate compound of the first layer;
14 after annealing the first layer, forming a second layer of a second
15 titanate compound comprising capacitor dielectric material on the
16 annealed first layer, the second layer not being exposed to a
17 temperature of 500°C or greater before deposition of a subsequent layer
18 thereover, the second titanate compound being different from the first
19 titanate compound; and
20 forming a second capacitor electrode over the second layer of
21 second titanate compound comprising capacitor dielectric material.
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1 33. A method of forming a capacitor comprising:
2 forming a first capacitor electrode;
3 forming a first layer of a first capacitor dielectric material over
4 the first capacitor electrode;
5 forming a second layer of a second capacitor dielectric material
6 on the first layer, one of the first and second materials comprising a
7 titanate compound and the other comprising Ta_2O_5 ; and
8 forming a second capacitor electrode over the second layer of
9 second capacitor dielectric material.

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11 34. The method of claim 33 comprising forming the second
12 capacitor electrode to impart one of compressive or tensile stress on
13 the second layer of the second capacitor dielectric material during
14 second electrode formation.

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16 35. The method of claim 34 comprising forming the second
17 capacitor electrode to predominately comprise a material selected from
18 the group consisting of TiN_x , WN_x , TaN_x , $PtRh_x$, $PtRu_x$, $PtIr_x$, and
19 mixtures thereof.
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1 36. The method of claim 34 comprising doping the second
2 capacitor electrode during its formation with a conductivity enhancing
3 impurity to achieve a selected stress on the second capacitor dielectric
4 material.

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6 37. A method of forming a capacitor comprising:
7 forming a first capacitor electrode;
8 forming a first layer of a first capacitor dielectric material over
9 the first capacitor electrode;

10 annealing the first layer of the first capacitor dielectric material
11 at a temperature of at least 300° C for a time period sufficient to
12 achieve a selected crystalline structure of the first capacitor dielectric
13 material of the first layer;

14 after annealing the first layer, forming a second layer of a second
15 capacitor dielectric material on the annealed first layer, the second layer
16 not being exposed to a temperature of 500°C or greater before
17 deposition of a subsequent layer thereover, one of the first and second
18 materials comprising a titanate compound and the other comprising
19 Ta_2O_5 ; and

20 forming a second capacitor electrode over the second layer of
21 second capacitor dielectric material.
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Sub B2
1 38. A capacitor comprising a pair of capacitor electrodes having
2 capacitor dielectric material therebetween comprising a composite of two
3 immediately juxtaposed and contacting, yet discrete, layers of the same
4 capacitor dielectric material.

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6 39. The capacitor of claim 38 wherein one of the discrete layers
7 is crystalline and the other is amorphous.

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9 40. The capacitor of claim 38 wherein both of the discrete
10 layers are crystalline, and comprising an interface where the discrete
11 layers contact which is characterized by a perceptible change in
12 crystallinity from one layer to the other.

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14 41. The capacitor of claim 40 wherein the perceptible change
15 in crystallinity is characterized by a perceptible lateral shift in grain
16 boundaries from one layer to the other.

Sub B17
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18 42. The capacitor of claim 38 wherein the same capacitor
19 dielectric material comprises a titanate compound.

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21 43. The capacitor of claim 38 wherein the same capacitor
22 dielectric material comprises Ta_2O_5 .

1 44. A capacitor comprising a pair of capacitor electrodes having
2 capacitor dielectric material therebetween comprising a composite of two
3 immediately juxtaposed and contacting, yet discrete, layers of two
4 different capacitor dielectric materials, said two capacitor dielectric
5 materials including two different titanate compounds.

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7 45. A capacitor comprising a pair of capacitor electrodes having
8 capacitor dielectric material therebetween comprising a composite of two
9 immediately juxtaposed and contacting, yet discrete, layers of two
10 different capacitor dielectric materials, one of the two different materials
11 comprising a titanate compound and the other comprising Ta_2O_5 .

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13 Add B3
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15 Add D27
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